

CLAIMS:

[C001] 1. A method comprising:

(a) attaching a lens array to a substrate with lenses of the lens array situated opposite the substrate;

(b) surrounding a periphery of the lens array with a packaging material, the packaging material being attached to the substrate;

(c) planarizing the packaging material, the planarized packaging material having a height higher than a height of the lens array; and

(d) providing alignment holes through the packaging material, the alignment holes being aligned with respect to positions of the lenses.

[C002] 2. The method of claim 1 wherein the package substrate comprises a flexible substrate and wherein the packaging material is additionally attached to the lens array.

[C003] 3. The method of claim 1 wherein (b) comprises providing a dam around the periphery of the lens array and wherein the packaging material comprises the dam.

[C004] 4. The method of claim 3 wherein the dam comprises a first dam and wherein (b) further comprises

(i) providing a second dam around the first dam;

(ii) filling space between the first and second dams with filler material, and

(iii) planarizing the first and second dams and the filler material to form the packaging material.

[C005] 5. The method of claim 4

wherein (b) further comprises, prior to (ii), attaching a stop block to the substrate, and

wherein the first and second dams have thicknesses greater than a thickness of the stop block.

[C006] 6. The method of claim 1 further comprising

(e) cutting the substrate to form a lens package comprising the lens array, a remaining portion of the packaging material, and the alignment holes.

[C007] 7. The method of claim 6 further comprising

(f) mechanically coupling the substrate of the lens package and an optical module by inserting pins through the alignment holes.

[C008] 8. The method of claim 7 wherein the optical module comprises optical elements selected from the group consisting of, optical fibers, photo emitters, and photo detectors, and combinations thereof, at least some of the optical elements being aligned with respective lenses during (f).

[C009] 9. The method of claim 7 wherein (f) comprises attaching pins to one of the lens package and the optical module prior to positioning the lens package adjacent the optical module.

[C010] 10. The method of claim 7 wherein (f) comprises attaching pins to one of the lens package and the optical module after positioning the lens package adjacent the optical module.

[C011] 11. The method of claim 7 wherein the lens package comprises a first lens package and the optical module comprises a first optical module and wherein (f) comprises mechanically coupling the first lens package, a second lens package, the first optical module, and a second optical module by inserting the pins.

[C012] 12. The method of claim 11 wherein the first and second optical modules comprise optical elements selected from the group consisting of, optical fibers, photo emitters, and photo detectors, and combinations thereof, at least some of the optical elements being aligned with respective lenses during (f).

[C013] 13. A method comprising:

attaching a lens array to a substrate with lenses of the lens array situated opposite the substrate;

surrounding a periphery of the lens array with a first dam, the first dam being attached to the substrate and to the lens array;

providing a second dam around the first dam;

filling space between the first and second dams with filler material;

planarizing the first dam, the second dam, and the filler material to form packaging material having a height higher than a height of the lens array;

providing alignment holes through the packaging material, the alignment holes being aligned with respect to positions of the lenses;

cutting the substrate to form a lens package comprising the lens array and a remaining portion of the packaging material; and

mechanically coupling the substrate of the lens package and an optical module by inserting pins through the alignment holes, wherein the optical module comprises optical elements selected from the group consisting of, optical fibers, photo emitters, and photo detectors, and combinations thereof, at least some of the optical elements being aligned with respective lenses of the lenses.

[C014] 14. The method of claim 13 further comprising, prior to filling, attaching a stop block to the substrate, and wherein the first and second dams have thicknesses greater than a thickness of the stop block.

[C015] 15. The method of claim 7 wherein manually coupling comprises attaching pins to one of the lens package and the optical module prior to positioning the lens package adjacent the optical module.

[C016] 16. The method of claim 7 wherein manually coupling comprises attaching pins to one of the lens package and the optical module after positioning the lens package adjacent the optical module.

[C017] 17. The method of claim 13 wherein the lens package comprises a first lens package and the optical module comprises a first optical module and wherein manually coupling comprises mechanically coupling the first lens package, a second lens package, the first optical module, and a second optical module by inserting the pins.

[C018] 18. The method of claim 17 wherein at least one of the optical elements is situated at a distance of approximately one focal length from a respective lens.

[C019] 19. A structure comprising:

a substantially transparent package substrate;

a lens array attached to the substrate with lenses of the lens array situated opposite the substrate;

packaging material surrounding at least the periphery of the lens array, the packaging material including at least two alignment holes aligned with respect to positions of the lenses.

[C020] 20. The method of claim 19 wherein the package substrate comprises a flexible substrate and wherein the packaging material is additionally attached to the lens array.

[C021] 21. The structure of claim 19 wherein the packaging material comprises a dam.

[C022] 22. The structure of claim 21 further comprising filler material surrounding the dam, wherein packaging material comprises the dam and the filler material.

[C023] 23. The structure of claim 19 wherein a lens package comprises the package substrate, the lens array, and the packaging material, and further comprising

an optical module mechanically coupled to the lens package by pins in the alignment holes.

[C024] 24. The structure of claim 23 wherein the optical module comprises optical elements selected from the group consisting of, optical fibers, photo emitters, and photo detectors, and combinations thereof, at least some of the optical elements being aligned with respective lenses during of the lens package.

[C025] 25. The structure of claim 24 wherein at least one of the optical elements is situated at a distance of approximately one focal length from a respective lens.

[C026] 26. The structure of claim 23 wherein the lens package comprises a first lens package and the optical module comprises a first optical module and further comprising a second lens package and a second optical module, the pins coupling the first lens package, the second lens package, the first optical module, and the second optical module in an orientation with the lenses of the first lens package facing the lenses of the second lens package.

[C027] 27. The structure of claim 26 wherein the first optical module comprises optical elements selected from the group consisting of, optical fibers, photo emitters, and photo detectors, and combinations thereof, at least some of the optical elements being aligned with respective lenses.

[C028] 28. A structure comprising:

a substantially transparent package substrate;

a lens array attached to the substrate with lenses of the lens array situated opposite the substrate;

packaging material surrounding at least the periphery of the lens array, the packaging material including at least two alignment holes aligned with respect to positions of the lenses and having a height higher than a height of the lens array, the package substrate, the lens array, and the packaging material forming a lens package;

an optical module mechanically coupled to the lens package by pins in the alignment holes, the optical module comprising optical elements, at least some of the optical elements being aligned with respective lenses during of the lens package and situated at a distance of approximately one focal length from a respective lens.

[C029] 29. The structure of claim 28 wherein the optical elements are selected from the group consisting of, optical fibers, photo emitters, and photo detectors, and combinations thereof.

[C030] 30. The structure of claim 29 wherein the lens package comprises a first lens package and the optical module comprises a first optical module and further comprising a second lens package and a second optical module, the pins coupling the first lens package, the second lens package, the first optical module, and the second optical module in an orientation with the lenses of the first lens package facing the lenses of the second lens package.